across it. The instant-light emission upon impact was too weak to detect, but the pickup coil registered a magnetic field (Channel 4). After about 125 microseconds the voltage measured across the resistor began to rise (Channel 3), indicating a current of about 25 microamperes. Then the photodiode recorded a sudden light pulse (Channel 1), and the magnetic pickup coil (Channel 4) recorded a brief, but strong magnetic field oscillation.

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Nitrogen Dissociation in Earth's Lower Thermosphere

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The reaction of nitrogen atoms (N) with oxygen (O_2) is important in the formation of nitric oxide (NO) in Earth's lower thermosphere. This reaction is particularly sensitive to the internal state of the N atom. The reaction proceeds very slowly if the N atoms are in their ground electronic state (^4S), but becomes much faster for electronically excited N atoms (^2D or ^2P). Thus the amount of NO in the lower thermosphere is dependent on the population of excited-state N atoms. Employing current models of the lower thermosphere, a change in the population of N ^2D from 60% of the total N atom population to 50% results in an 80% decrease in the NO density. Given this uncertainty in the current models, a better understanding of the N atom population distributions is necessary.

Nitrogen atoms in the lower thermosphere are produced by electron impact dissociation of N_2 and the dissociative recombination of N_2^+. Laboratory measurement of electron-impact dissociation of the ground state N_2 ($X^1\Sigma_g^+$) molecule found that equal amounts of ^2D and ^4S nitrogen atoms were produced. This distribution of N atoms gives less ^2D than is used in the model, resulting in an even larger discrepancy between the measured and modeled NO density. To help resolve this discrepancy, large-scale quantum chemical calculations on the dissociation pathways of N_2 have been carried out. The first figure shows

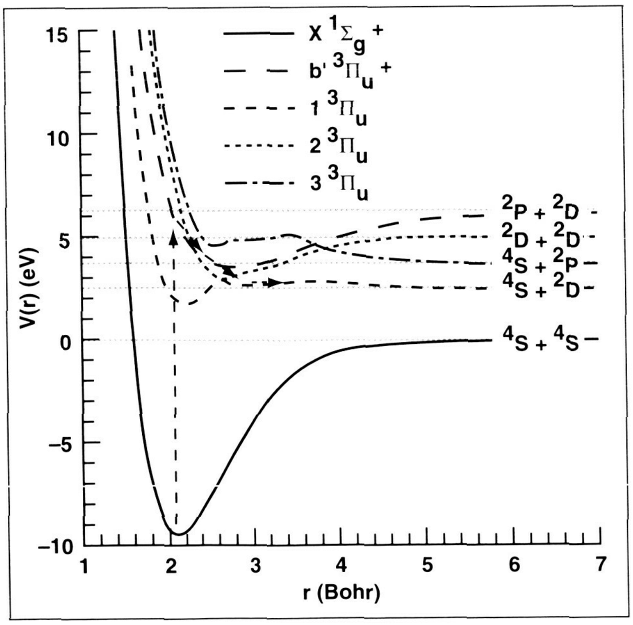

Fig. 1. Dissociation pathways of the $X^1\Sigma_g^+$ state of N_2.

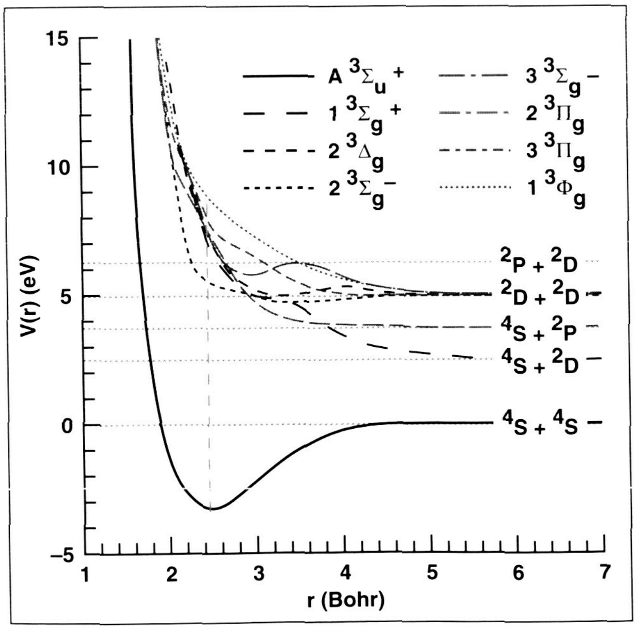

Fig. 2. Dissociation pathways of the $A^3\Sigma_u^+$ state of N_2.

the dominant dissociation pathway of the N_2 ground state. This is a predissociative process in which the dissociation products are $^4S + {}^2D$, in agreement with laboratory measurements.

Electron collisions with the X state of N_2 also produces the metastable $A^3\Sigma_u^+$ state. The A state has been observed in dayglow and in the aurora. The second figure presents a number of dissociation pathways of the A state. Unlike the X state, the dissociation of the A state favors a direct process in which the lower state is directly excited to a repulsive state. The dissociation products distribute among the ^4S, ^2D, and ^2P states.

Calculations of the electron-impact excitation cross sections of the X and A states to the predissociative or dissociative states show that the A state excitation cross sections are of the same magnitude or larger than the X state. Based on these results, the distribution of N atoms with 60% in the ^2D state is favored.

A factor that has not been considered so far in the modeling is the interaction of the A state of N_2 with the O atom to form NO. Since the A state is expected to be more reactive than the ground state, this will provide another source of NO and further lessens the discrepancy between modeling and measurement.

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Transient Meteor Activity

Peter Jenniskens

In 1997, Ames Research Center proved to be uppermost in studies of transient meteor activity. Meteor storms and lesser outbursts are spectacular natural phenomena that have eluded systematic study with modern techniques. During an outburst, meteor rates increase above the normal annual activity for a period that typically ranges from 1 to 24 hours. Little is known about why it sometimes "rains stars" at night. An answer to this question is key to the information that is particular to these events. For example, outbursts provide a unique window on how comets shed the large millimeter-to-centimeter-size dust grains that contain most of the mass lost by comets in the form of dust.

With the archiving center at Ames, a Global Meteor Scatter Network (Global-MS-Net) was made operational this year; it has stations in Finland, Hawaii, Austria, and Belgium, and two stations in Japan, operated by amateur astronomers. For the first time, meteor activity was monitored on a 24-hour and global basis (see the figure), but not yet in the Southern Hemisphere. Three outbursts were detected, all of known meteor streams: the Perseids, Leonids, and Ursids. On four occasions, the network provided upper limits to possible outburst activity reported by meteor observers and amateur astronomers.

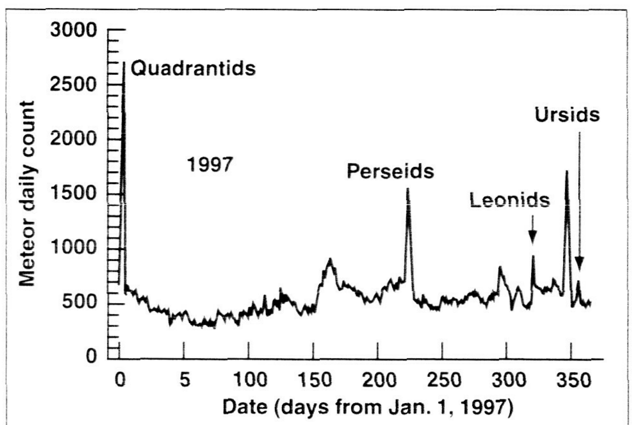

Fig. 1. Graph of the daily meteor count during the year of 1997 as measured by the Finnish Global-MS-Net station of Ilkka Yrjölä in Kuusankoski. The meteor streams discussed in the text are indicated.

Important progress was made toward determining how the Global-MS-Net detection of an outburst from the dust of a long-period comet can help predict its return in future years. The key is in the position of the major planets, because their gravitational perturbations affect the motion of the cometary dust trail that is responsible for the outbursts. Once it has been